DOCUMENT RESUME

ED 171 580 **SE 027 809**

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TITLE	A Study of the Research Priorities as Perceived by Public School Science Personnel.
PUB DATE	Mar 79
NOTE	14p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (52nd, Atlanta, Georgia, March 21-23, 1979); Tables marginally legible
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Cognitive Development; *Educational Research; *Opinions; Research; *Research Needs; *Science Education; *Science Teachers; Teacher Attitudes
IDENTIFIERS	Research Reports

ABSTRACT

Science teachers participating in a seminar were asked to respond to the following question: "Based on your teaching experiences, what kinds of research related to classroom teaching practices would you like to see done?" The responses were classified into 12 logical factors by a panel of reviewers, and ranked according to frequency of response. As a result, the most important concerns of the teachers were research on the influence of science classroom experiences on cognitive achievement; research on the effects of teaching science in the interdisciplinary mode as it relates to areas such as mathematics, social studies, and reading; and research on motivational techniques that relate to learning and continual involvement in science. (BB)

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A Study of the Research Priorities as Perceived by Public School Science Personnel

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A report presented at the
National Association for
Research in Science Teaching
Atlanta, Georgia

March 1979

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A Study of the Research Priorities as Perceived by Public School Science Personnel

Introduction

The influence of science education research on classroom teaching practice is not as great as many would like it to be. This lack of influence may be due to a number of reasons. Many feel that research findings and their implications are inadequately communicated to classroom teachers. However, this lack of influence may also be due to the perceived lack of relevance for teachers as they look for guidance to deal with daily concerns and decisions faced in the classroom. A mechanism needs to be designed to facilitate the identification by teachers of research problems relevant to teachers needs.

Recently the National Association for Research in Science Teaching (NARST) and the National Science Teachers Association (NSTA) supported a cooperative effort designed to increase the influence of classroom science teachers on science education research and to improve teachers perception of the relevancy of science education research. This should serve to establish better credibility of researchers with teachers and of teachers with researchers thus making the impact of research on classroom practice more likely. A major objective of this effort was stated as follows:

> To obtain input from teacher identifying relevant research questions related to classroom practice.

This report includes the processes, initial results, and planned future activities and procedures related to the above objective.

Procedures

A question to solicit teachers' suggestions for needed research related to classroom practice was drafted by the Research in Science Teaching Committee (NSTA)

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and included in a questionnaire sent to participants in the monograph-seminar series sponsored by NSTA. The seminars are the mechanism for dissemination of the information in the monograph: What Research Says to the Science Teacher (Rowe, 1978). The following question was responded to by 145 science teaching personnel:

> "Based on your teaching experiences, what kinds of research related to classroom teaching practices would you like to see done?"

Data were also collected from each participant on the position, content area, experience, community type, and rankings of the six research topics presented at the seminar. One-hundred and thirty-seven usable sets of data were returned to the NSTA headquarters. The responses to the research question were examined by a panel of four science educators who classified them into logical factors based on the majority opinion of the panel.

The demographic topic ranking and the category of the research response data were analyzed to determine frequency, central tendency, and dispersion characteristics. Also, the demographic information was compared to the topic rankings and type of research response through forward stepwise regression analysis to determine the order and set of teacher variables which predicted the greatest amount of variance in the research and ranking responses.

Results

Results from data analysis on the demographic characteristics of the respondents are given in Table 1. As can be noted, the majority (62%) were males; fifty percent held teaching positions; while, forty-eight percent had department head duties. About half taught biology (45%) and/or chemistry (46%); twenty-two percent taught physical science. Most of the participants (94%) had more than five years experience; while, fifty-two percent had more than

Table 1

Demographic Information on Participants in the NSTA Research Seminar who Responded to the Inquiry on Science Education Research Priorities

VARIABLE		f	%
SEX	Males	85	62
	Females	52	38
POSITION	Teacher	68	50
	Department Chairman	66	48
	Science Coordinator	21	15
	Administrator	3	2
	Other	3	2
CONTENT AREA	Biology	62	45
	Chemistry	63	46
	Earth Science	17	12
	General Science	21	15
	Physical Science	30	22
	Physics	35	26
EXPERIENCE	1 - 5 years	8	6
	5 - 10 years	25	18
	10 - 15 years	33	24
	> 15 years	71	52
COMMUNITY TYPE	Small Town	23	17
	Rural	5	4
	Small City	38	28
	Large City	57	42
	County	3	2
	Other	1	<1

fifteen years experience. Large and small cities were represented by most of the participants (42% and 28% respectively).

The interest rankings of the Research Seminar topics are presented as Table 2. The highest degree of interest was registered for the topic on teaching strategies effectiveness with the least interest shown in reading and language development through science. Other rankings can be examined in Table 2.

As was mentioned earlier, the research concerns of the participants were classified into logic factors by a panel of reviewers. This process resulted in 12 identifiable areas of research concern which are presented as Table 3. As can be noted, the category represented by the most responses (22%) relates to the influences of science classroom experiences on cognitive achievement. The other response categories, their frequency of representing statements, and percent of total can be examined in Table 3.

The stepwise multiple regression indicated that there was no strong set of demographic variables which can be used to predict research topic ranking or research concerns. In six cases, there was no single significant predictor. In the other cases, three or four demographic variables predicted small amounts of variance. On the average, four demographic variables accounted for twenty percent or less of the variance on the ranking and concerns (see Tables 4 and 5).

Planned Procedures

Further research on the research concerns of science teachers is needed and planned. First, the data collected through the NSTA research seminars are not representative of the science teacher population because it does not include elementary teachers. Second, no priorities can be set on the research statements because the individuals submitted their own concern but did not examine it in

Table 2

Interest Rankings of NSTA Research Seminar Participants on the Seminar Topics (n = 137)

TOPIC	RESPONSES* 1 f	1 %	2 f	2 %	3 f	3 %	4 f	4 %	5 f	5 %	6 f	6 %	$\bar{x}$	MODE	S.D.
How Teaching Strategies Affect Students: Implications for Teaching Science	(52)	38	(40)	29	(21)	15	(12)	9	(7)	5	(4)	3	2.20	4	1.35
The Role of the Laboratory in Secondary School Science Programs	(44)	32	(33)	24	(20)	15	(16)	12	(10)	7	(12)	9	2.60	1	1.65
Learning Science from Planned Experiences	(7)	5	(22)	16	(32)	23	(24)	18	(31)	23	(18)	13	3.70	3	1.54
Relating Student Feelings to Achievement in Science	(10)	7	(24)	18	(22)	16	(33)	24	(24)	18	(22)	16	3.70	4	1.58
Analyzing the Questioning Behaviors of Science Teachers	(13)	10	(7)	5	(20)	15	(32)	23	(35)	26	(28)	20	4.07	5	1.59
Science: A Basic for Language and Reading Development	(12)	9	(8)	6	(19)	14	(17)	12	(28)	20	(51)	37	4.37	6	1.72

*1 = most interested, 6 = least interested

Table 3

Research Concerns of Secondary Science Teachers as Classified by a Panel of Science Educators

RESPONSE CATEGORIES	f	%
1. Research on the influence of science classroom experiences on cognitive achievement.	20	22
Examples:[4]		
How teaching strategies affect student achievement		
Which teaching methods work best for certain basic concepts? Lecture, lab, inquiry, rote, LAPS, etc.		
Research related to productivity of various patterns of interaction between teachers and students		
2. Research on the effects of teaching science in the interdisciplinary dimension as it relates to areas such as mathematics, social studies, and reading.	13	15
Examples:		
The relationship between using calculators in science class and an improvement in mathematical ability		
Relationship between math skills and science achievement		
Improving reading and language skills while teaching science		
The most effective methods to approach social issues in science		
3. Research on motivational techniques that relate to learning and continue involvement in science.	12	13
Examples:		
Research related to promising practices in teaching science to reluctant learners		
Techniques which generate enthusiasm in all students		
Ways of encouraging more students to take upper level courses		
4. Research on the effectiveness of laboratory experiences in the science classroom.	11	12
Examples:		
The effect of traditional lab experiences versus those involving inquiry		
Detailed look at benefits of laboratory science		
Use of safe practices in a laboratory experience		
5. Research on the influences of science classroom experiences on pupil attitudes.	11	12
Examples:		
Evaluation of importance of supplementary science experiences and their effect on attitude development		
Relationship of classroom management techniques to student feelings about science		
A correlation between "hand-on" or cognitive experiences and attitudes toward science in general		

[4]*Examples of the teacher statements are included for clarification.*

Table 3 (continued)

RESPONSE CATEGORIES	f	%
6. Research on the selection and sequencing of science content in the curriculum. *Examples:* Knowledge versus process: finding a balance in science instruction Effectiveness of sequencing of science courses (e.g., biology, chemistry, physics) Effectiveness of various science programs such as unified science	10	11
7. Research on the relationship of student cognitive development and learning styles to science curriculum development and teaching. *Examples:* Matching students' cognitive development to the teaching methods Learning styles of students and related effective teaching strategies Ways to identify the learning needs of students	9	10
8. Research on the effectiveness of supplementary science experiences (e.g., projects, clubs). *Examples:* Effects of student science projects on learning scientific principles and application of scientific methods to everyday situations Effectiveness of clubs and science fairs in teaching science Assisting students with the methods and procedures of project work	7	8
9. Research on and development of valid and reliable science testing and grading procedures. *Examples:* Pass - fail versus A - F grades Development of reliable evaluative instruments to measure effectiveness of science instruction (content and process) Effects of evaluation (grading) on student learning	6	7
10. Research on the influence of public school science experiences on success in college science courses. *Examples:* The retention of scientific facts from high school to college Various learning systems versus student success in college science courses Research which analyzes the forms of science education and correlates them to the success of the students in college	6	7

Table 3 (continued)

RESPONSE CATEGORIES	f	%
11. Research on effectiveness of individualized learning activities in science classes. *Examples:* Effects of individualized learning versus group pacing Effects of total contract courses versus lecture and exams How to manage idividualized laboratory programs	4	4
12. Research on the influence of teacher characteristics on pupil learning and attitudes. *Examples:* How the teacher's personality affects classroom learning Correlation between teachers' attitudes toward science and students' attitudes	3	3

Table 4

Results of Step-Wise Regression to Predict Ranking of Research Seminar Topic from Demographic Information

Dependent Variable	Demographic Predictor	Multiple R	Multiple R^2	r
How Teaching Strategies Affect Students: Implications for Teaching Science				NS
The Role of the Laboratory in Secondary School Science Programs	General Science	.25	.06	.25
	Biology	.33	.11	-.19
	Science Coordinator	.38	.15	.22
	Other	.42	.18	.19
	Large City	.45	.20	.13
Learning Science from Planned Experiences				NS
Relating Student Feelings to Achievement in Science				NS
Analyzing the Questioning Behaviors of Science Teachers	Other	.20	.04	-.19
	Biology	.24	.06	.16
	Earth Science	.29	.08	-.10
Science: A Basic for Language and Reading Development	Coordinator	.23	.05	-.23
	Earth Science	.26	.07	-.11
	Department Chairman	.31	.09	-.01
	General Science	.33	.11	-.13

Table 5

Results of Stepwise Regression to Predict Nature of Research Concern from Demographic Information

RESEARCH CATEGORY	DEMOGRAPHIC PREDICTOR	MULTIPLE R	MULTIPLE R^2	r
1*	Experience	.23	.05	.23
	Department Chairman	.32	.10	-.13
	Other	.40	.16	-.15
	Biology	.43	.18	-.19
	Chemistry	.46	.21	-.05
2				NS
3				NS
4	Earth Science	.25	.06	.25
	Chemistry	.33	.11	.20
	General Science	.41	.16	.21
	Rural	.46	.21	.17
5	General Science	.31	.09	.31
	Large City	.35	.12	-.13
	Chemistry	.38	.14	-.20
	Biology	.41	.17	-.20
	Experience	.44	.19	-.15
6				NS
7	County	.31	.10	.31
	Teacher	.40	.16	-.28
	Physics	.48	.23	.21
8	County	.36	.13	.36
	Small City	.41	.17	.18
	Physics	.45	.20	.18
	Science Coordinator	.48	.23	.09
	Experience	.50	.25	-.14
9	Other	.25	.06	.25
	Large City	.32	.10	.12
10	Rural	.26	.07	.26
	Physics	.35	.12	.21
	Small Town	.38	.14	.15
11	Other	.34	.12	.34
	Earth Science	.43	.19	.23
	Science Coordinator	.46	.21	-.10
12	Rural	.39	.15	.39

* Numbers reference Table 3

light of the full set of concerns.

In relation to the first short-coming, data are now (Winter, 1979) being collected from elementary teachers at selected sites in 9 states (Georgia, Pennsylvania, Michigan, Ohio, Florida, Kansas, Iowa, California and New York). These data will be analyzed and classified by using the same procedures followed with the secondary data.

In relation to the need for prioritizing the research concerns, procedures are planned to solicit a representative sample of science teachers from the NSTA, 1979, National Convention in Atlanta. These individuals will be asked to provide a limited amount of demographic data and then rank the 12 categories of research concerns given in Table 3 as to high or low priority on a scale of 1 - 10.

Conclusions

Any conclusions drawn at this time would be premature and extremely tentative; therefore, statements of inference are being withheld until the data set is more complete and more organized in relation to priorities. At that time the results of the study will be compared to the research priorities of science education researchers as determined by the NARST priorities study (Table 6) and efforts will be made to use these results to guide the practice and funding of research in science education.

Table 6

A Listing of the Factors Represented by the Research Priorities of Science Education Researchers*

FACTOR I ANALYZING AND APPLYING LEARNING THEORY

Mean Factor Rating	Item Mean	Factor Loading	Item Number	Statements
	2.5	.78	12	Application of learning and cognitive theories to concept formation.
	3.7	.65	25	Analysis of relationship between discipline (subject matter) structure and cognitive structure of the learner.
	2.7	.63	26	Analyze strategies for acquisition, retention and transfer of problem solving (critical thinking or inquiry skills) in students.
	4.8	.59	33	Construction of a theory of science instruction.
	3.5	.58	30	Application of learning and cognitive development theories to classroom instruction.
$\bar{\bar{X}}$ = 3.41	3.3	.41	24	Identification of factors which influence formation of attitudes in students, e.g., value clarification in environmental education, attitudes toward science and technology.
	3.2	.39	8	Definition and validation of goals of science instruction, e.g., balance between process and process objectives, philosophical and theoretical basis of science instruction, articulation of goals for students at all levels, K-16.
	4.0	.38	20	Identification and design of instructional materials in subject content areas for teachers essential to support successful science instruction.
	3.0	.36	23	Identification and development of teacher education strategies (inservice and preservice) designed to facilitate professional growth and concerns of teachers, including commitment to continued growth.

FACTOR II CONDUCTING NEEDS ASSESSMENTS

Mean Factor Rating	Item Mean	Factor Loading	Item Number	Statements
	3.4	.90	4	Needs assessment of current practices as a basis of decision making for the development of science curriculum and teacher materials at junior high or middle school level.
	3.5	.81	3	Needs assessment of current practices as a basis of decision making for the development of science curriculum and teacher education materials at elementary level.
$\bar{\bar{X}}$ = 3.42	3.7	.75	5	Needs assessment of current practices as a basis of decision making for the development of science curriculum and teacher education materials at senior high level.
	3.8	.60	6	Needs assessment of current practices as a basis of decision making for the development of science curriculum and teacher education materials at college level.
	2.7	.37	9	Identify what elements are essential in translating both research and development activities into classroom practice.

* from Yeany, R. H. and Capie, W. R. A factor-analytical study of the research priorities of science educators. Journal of Research in Science Teaching, 1978, 15 2, 167-172.

Table 6 (continued)

FACTOR III SOCIAL AND EDUCATIONAL POTPOURRI

Mean Factor Rating	Item Mean	Factor Loading	Item Number	Statements
	8.1	.58	17	Comparison of goals of science teaching today with those of 10-20 years ago as viewed by a variety of society's segments--e.g., parents, teachers, students, and teacher educators.
	5.3	.54	35	Analysis of residue effects of the NSF supported curriculum developments.
	6.7	.48	29	Analysis of factors which characterize the reluctant science teacher.
	5.6	.47	28	Influence of political and technological pressures on science instruction, science teacher manpower needs--e.g., public attitudes and science enrollments.
	4.1	.46	15	Analysis of effectiveness of instructional systems with specific goals and target populations--e.g., CBTE, PSI, Open Education, Mastery Learning, etc.
	5.6	.43	34	Identification of management skills needed for maintaining a viable learning classroom environment--e.g., discipline, grouping, bookkeeping skills.
$\bar{\bar{X}}$ = 5.35	5.0	.41	31	Description of current perceptions of middle school, high school and college graduates about the nature of life, matter and energy, about usefulness and desirability of alternative teaching modes and strategies.
	3.8	.33	22	Identification and validation of alternative evaluation schemes for teachers and pupils.
	4.0	.28	13	Analysis of decisions related to curriculum implementation--e.g., choosing, using and evaluating curriculum, including analysis of what science teachers see as key decisions.
	4.5	.27	16	Development of alternative instructional strategies for use with learners with special problems--e.g., EMR, bi-lingual, culturally deprived, non-reader, minorities, etc.

FACTOR IV DETERMINING THE EFFECTS OF ATTITUDES AND TEACHING ON LEARNING

Mean Factor Rating	Item Mean	Factor Loading	Item Number	Statements
	3.0	.60	11	Relationship between motivation, attitudes and performance (in both students and teachers).
	2.5	.60	10	Analysis of classroom teaching behaviors that facilitate science learning.
	4.4	.50	7	Identification and validation of specific teacher characteristics and knowledge which relate to successful teaching styles using enthnographic approaches.
	3.1	.44	32	Identification and validation of teaching behaviors and instructional strategies that facilitate student self-concept, knowledge and attitudes.
$\bar{\bar{X}}$ = 3.51	3.3	.40	24	Identification of factors which influence formation of attitudes in students, e.g., value clarification in environmental education, attitudes toward science and technology.
	2.9	.39	14	Identification and validation of strategies to assist preservice and inservice teachers in acquiring specific teaching skills.
	4.3	.38	19	Identification of characteristics of a professionally competent and committed teacher
	3.2	.37	27	Identification and validation of specific learner characteristics which relate to successful achievement in science.
	3.5	.30	21	Design of longitudinal studies to identify what kinds of gains are important to a variety of student populations.
	4.9	.26	18	Assessment of impact of non-school experience on students' knowledge in science, mathematics, social studies, etc.

FACTOR V DEVELOPING AND EVALUATING INTERDISCIPLINARY CURRICULA

Mean Factor Rating	Item Mean	Factor Loading	Item Number	Statements
	3.6	.73	1	Development and evaluation of instructional materials which draw from and integrate more fully sciences, social sciences, and mathematics.
$\bar{\bar{X}}$ = 4.05	4.5	.71	2	Development and evaluation of instructional materials which are integrated with non-science areas such as reading, language arts, fine arts, etc.